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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of: G.KNOWLTON and C. LUDWIG

Application No. 09/010,822

Group Art Unit: 3641

Filed: January 22, 1998

Examiner: Miller, E.

For: LOW TEMPERATURE AUTOIGNITION
COMPOSITION

Attorney Docket No.: 53293.5

Old Docket No.: 3756-399

DECLARATION OF CHRISTOPHER P. LUDWIG UNDER 37 C.F.R. §1.132

Commissioner for Patents
Washington, D.C. 20231

SIR:

I, Christopher P. Ludwig, hereby declare that:

1. I am a named inventor of the above-identified application, and, thus, I am familiar with the application and the invention claimed therein.
2. I presently hold the position of Senior Technologist and Principal Engineer at Talley Defense Systems, Inc., of Mesa, Arizona, the assignee of the application and the subject invention. I have 20 years experience in the field of pyrotechnics, and am a named inventor on eight patents directed to pyrotechnic materials and devices.
3. I was awarded B.S. degree in chemical engineering from The State University of New York at Buffalo in 1984.
4. I have reviewed and understand the Final Office Action mailed January 20, 2000, and the prior art references cited therein.
5. The invention, as claimed in the above-identified application is a low temperature autoignition composition for safely initiating combustion of a main

pyrotechnic charge in a gas generator or pyrotechnic device exposed to flame or a high temperature environment. The autoignition composition requires an intimate mixture of an oxidizer composition and a powdered metal fuel. The oxidizer composition comprises silver nitrate or a comelt or mixture comprising silver nitrate and at least one additional component, selected from the group consisting of an alkali metal nitrate, an alkaline earth metal nitrate, a complex salt nitrate, a dried, hydrated nitrate, an alkali metal chlorate, an alkali metal perchlorate, an alkaline earth metal chlorate, an alkaline earth metal perchlorate, ammonium perchlorate, sodium nitrite, potassium nitrite, silver nitrite, a complex salt nitrite, a solid organic nitrate, and a solid organic nitrite. The oxidizer composition has at least one crystalline phase transition, melting point, eutectic point, or peritectic point at a temperature of no more than about 250°C. The metal fuel is present in an amount at least sufficient to provide a substantially stoichiometric mixture of metal fuel and oxidizer, and the metal fuel and oxidizer are sufficiently intimately mixed to ensure a sufficient degree of contact in the composition between the oxidizer and the metal fuel to provide an autoignition composition having an autoignition temperature of no more than about 232°C. The intimate mixing of the fuel and oxidizer is required in the present invention to provide the contact between the oxidizer and the metal fuel that is necessary to obtain proper autoignition, as the reaction or burning rate and ease of autoignition of the compositions of the invention increase as mix intimacy and homogeneity increases.

6. The Final Office Action cited Sammons et al. in view of Sidebottom, Garner, Healy, and Ellern in rejecting claims 1, 13 to 18, and 26 to 29, as being obvious. Those references, whether taken alone or in combination, do not teach or suggest an intimate mixture of the presently claimed metal fuels and oxidizer compositions, and, thus, do not teach or suggest the presently claimed autoignition compositions.

7. Sammons et al. disclose composite propellants that contain an oxidizer and a metal fuel that are dispersed within a polymethylenenitramine based binder matrix. The dispersion of the oxidizer and fuel, disclosed by Sammons, et al. within the binder matrix prevents the intimate mixture of the oxidizer and fuel required in the

present invention. That is, as the fuel and oxidizer are dispersed in the binder, the fuel and oxidizer are separated by the binder. Therefore, there is no intimate mixing between the oxidizer and the fuel in the compositions disclosed by Sammons et al. Thus, the propellants taught by Sammons et al. are outside the scope of the present invention.

8. Although the secondary references teach the use of silver nitrate as an oxidizer, the use of silver nitrate as the oxidizer in the propellant compositions taught by Sammons would not provide the presently claimed invention. As discussed above, Sammons fails to teach or suggest an intimate mixture of the fuel and oxidizer disclosed by Sammons. Therefore, even if a silver nitrate oxidizer was used in the propellants disclosed by Sammons et al., it would not provide the present invention. The binder disclosed by Sammons et al. would prevent any substantial contact between the silver nitrate oxidizer and metal fuel, and, thus, the required intimate mixture of metal fuel and oxidizer would not be formed.

9. The Final Office Action also states that Ellern, at pages 296 to 300, teaches, "the melting point and decomposition temperature of silver nitrate, and discusses the reaction of solid fuels with solid oxidizers as related to melting temperature. This would seem to suggest the relatively low decomposition or autoignition (spontaneous ignition) temperature of such compositions." However, Ellern specifically states, in the sentence bridging pages 297 and 298, that there is a scarcity of systematic data regarding the initiation temperature of fuel-oxidizer mixtures that restricts general statements. Moreover, although Ellern teaches that the melting point of silver nitrate is 214°C, Ellern, in Tables 29 and 30, only discloses metal/oxidizer binary mixtures and ignition mixtures having initiation temperatures of at least 300°C, which is outside the scope of the present claims. Also, as discussed above, substituting silver nitrate for the oxidizer taught by Sammons et al. does not provide the present invention, as it does not provide the intimate mixture of oxidizer and fuel of the present invention.

10. The Final Office Action also rejected claims 1, 13 to 15, and 26 to 29 as being obvious over Halliday et al., and claims 1, 13 to 16, and 25 to 29 as being

obvious over Halliday et al. in combination with Tepper and Ellern.

11. However, the compositions Halliday et al. disclose are clearly distinguishable from those of the present invention. Halliday et al. disclose explosive "water-in-fuel" and "melt-in-fuel" emulsions. The emulsions Halliday et al. teach have a continuous fuel phase and a discontinuous oxidizer phase, where the continuous fuel phase is formed from a substance that softens above ambient temperature, and the discontinuous oxidizer phase is typically a nitrate or perchlorate. All of the continuous phase fuels disclosed by Halliday et al. are non-metals. Halliday et al. do disclose the addition of a density-reducing agent dispersed within the continuous phase. Optionally, a solid fuel, such as atomized aluminum, is blended with the density-reducing agent in the continuous fuel phase. As the metal fuel is dispersed within the continuous fuel phase, the dispersion prevents all but incidental contact with the oxidizer in the discontinuous phase. Therefore, Halliday et al. fail to teach or suggest an intimate mixture of metal fuel and oxidizer. That is, the intimate mixture of fuel and oxidizer required in the present invention does not exist in the disclosed emulsion, and the explosive emulsions taught by Halliday et al. are thus outside the scope of the claimed invention.

12. The substitution of the metals taught by Tepper for the aluminum in the emulsions Halliday et al. disclose would not provide the present invention, as such a composition would lack the intimate mixture of oxidizer and fuel required in the present invention. Tepper discloses metals that can be used in castable pyrotechnic compositions that are blended with molten salt mixtures at temperatures below 250°C. Moreover, Tepper discloses that the castable compositions should not react spontaneously when the metal is mixed with the molten salt mixtures at temperatures below 250°C. Therefore, Tepper teaches away from the presently claimed autoignition compositions. That is, the compositions Tepper discloses have high temperature stability, and Tepper discloses that they should not autoignite at a temperature of less than 250°C, as do the presently claimed autoignition compositions, which autoignite at a temperature of no more than about 232°C.

13. Similarly, the substitution of the salt mixtures containing silver nitrate that Ellern discloses melt at temperatures ranging from 52° to 212°C for the oxidizer in the compositions disclosed by Halliday et al. would not provide the presently claimed autoignition compositions, as the resulting composition would not provide an intimate mixture of metal fuel and oxidizer as presently claimed. Blending the metal fuel into the continuous fuel phase prevents intimate mixing of the fuel and the oxidizer, as the oxidizer forms the discontinuous phase.

14. In rejecting claims 1, 13 to 15, and 26 to 29 as allegedly being obvious, the Final Office Action cited Poole et al. in view of Ferrando et al., Katzakian et al., Halliday et al., and Yabsley et al. In particular, Poole et al. are cited as disclosing an autoignition composition comprising a hydrazine salt of nitrotriazolone ("HNTO").

15. Poole et al. disclose ignition compositions for inflator gas generators that comprise HNTO and an oxidizer, where HNTO is the hydrazine (H_2NNH_2) salt of 3-nitro-1,2,4-triazole-5-one, otherwise known as nitrotriazolone ("NTO"). Optionally, the disclosed compositions may also include a metal additive, as a booster ignition material. Poole et al. do not teach or suggest that the metal additive should be present in an amount at least sufficient to form a stoichiometric mixture of metal and oxidizer, as is required in the present invention. Moreover, the only composition exemplified by Poole et al. that includes a metal contains 78 percent HNTO, 18 percent sodium nitrite, and only 2 percent boron, an amount of boron significantly less than the amount required for a stoichiometric mixture of boron and oxidizer. Therefore the compositions disclosed by Poole et al., are outside the scope of the presently claimed autoignition compositions. Accordingly, substituting the oxidizers taught in the secondary references for the oxidizer taught by Poole et al. would still not provide the presently claimed invention, as the resulting composition would still not contain an amount of metal at least sufficient to form a stoichiometric mixture of metal fuel and oxidizer.

16. I declare further that all statements made in this Declaration of my own knowledge are true, that all statements made on information and belief are believed to be true, and further, that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or

imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of any patent that may issue from the present application.

Respectfully submitted,

Date 19 JUNE, 2000

By: Christopher P. Ludwig
Christopher P. Ludwig